Applicant  : Niranjan Damera-Venkata et al.      Attorney's Docket No.:  10017903-1
Serial No.  : 10/027,523                         Amendment dated October 27, 2004
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## Amendments to the Claims

The following Listing of Claims replaces all prior versions, and listings, of claims in the application.

Listing of Claims:

Claim 1 (currently amended):  A method of generating a graphical bar code, comprising:

generating a sequence of graphical code words corresponding to a graphical encoding of a message;

halftoning regions of an original image incorporating errors diffused among regions of the original image and computed based at least in part upon modulations in the graphical bar code corresponding to the [[a]] graphical encoding of the [[a]] message, wherein halftoning comprises generating regions of a base image based upon propagation of errors to corresponding regions of the original image; and

modulating regions of the base image based upon the sequence of graphical code words to produce corresponding regions of the graphical bar code.

Claim 2 (original):  The method of claim 1, wherein halftoning comprises computing quantization errors for respective regions of the graphical bar code.

Claim 3 (original):  The method of claim 2, wherein the computed quantization errors are invariant to the graphically encoded message.

Claim 4 (original):  The method of claim 3, wherein average block errors are diffused among regions of the original image.

Claim 5 (currently amended):  The method of claim 1 [[2]], wherein halftoning comprises modifying original image regions with diffused errors to produce corresponding regions of a modified original image.

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Claim 6 (original): The method of claim 5, further comprising applying a matrix-valued error filter to compute quantization errors to be diffused.

Claim 7 (original): The method of claim 5, wherein quantization errors are computed based at least in part upon a comparison of regions of the modified original image with corresponding regions of the graphical bar code.

Claim 8 (currently amended): The method of claim 5, further comprising quantizing regions of the modified original image to produce corresponding regions of the [[a]] base image.

Claim 9 (original): The method of claim 8, wherein quantizing comprises thresholding regions of the modified original image.

Claim 10 (original): The method of claim 9, wherein regions of the modified original image are thresholded at an intermediate gray level.

Claim 11 (original): The method of claim 8, wherein quantizing comprises assigning to regions of the base image respective representative quantized regions selected from a subset of possible representative halftone regions.

Claim 12 (original): The method of claim 11, wherein the subset of possible representative quantized regions consists of an all-dark representative quantized region and an all-bright representative quantized region.

Claims 13-15 (canceled)

Claim 16 (currently amended): The method of claim 1 [[15]], wherein modulating base image regions comprises applying an invertible graphical operation between regions of the base image and graphical code words.

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Claim 17 (currently amended): The method of claim 1 [[14]], wherein one or more of the graphical code words are non-information-encoding and the remaining graphical code words are information-encoding.

Claim 18 (original): The method of claim 17, wherein information-encoding graphical code words and non-information encoding graphical code words are distinguishable on the basis of average gray value.

Claim 19 (original): The method of claim 18, wherein information-encoding graphical code words have gray values within a selected gray value range.

Claim 20 (original): The method of claim 17, wherein one or more non-information encoding graphical code words do not encode modulations into the graphical bar code during encoding.

Claim 21 (original): The method of claim 17, wherein one or more non-information encoding graphical code words visually enhance regions of the graphical bar code when encoded.

Claim 22 (original): A computer program for generating a graphical bar code, the computer program residing on a computer-readable medium and comprising computer-readable instructions for causing a computer to:

generate a sequence of graphical code words corresponding to a graphical encoding of a message;

halftone regions of an original image incorporating errors diffused among regions of the original image and computed based at least in part upon modulations in the graphical bar code corresponding to the [[a]] graphical encoding of the [[a]] message, wherein halftoning comprises generating regions of a base image based upon propagation of errors to corresponding regions of the original image; and

modulate regions of the base image based upon the sequence of graphical code words to produce corresponding regions of the graphical bar code.

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Claim 23 (currently amended): A method of decoding a graphical bar code, comprising:

generating a base image having halftoned ~~halftone regions representative of an original image by halftoning~~ regions of an ~~the~~ original image incorporating diffused errors ~~diffused among regions of the original image and~~ computed based at least in part upon modulations in the graphical bar code ~~corresponding to a graphical encoding of a preselected message~~;

graphically demodulating the graphical bar code based on the base image to recover graphical code words embedded in the graphical bar code;

probabilistically comparing the recovered graphical code words ~~regions of the base image~~ to a set of graphical code words to obtain a sequence of graphical code words corresponding to a graphical encoding of a message; and

decoding the sequence of graphical code words to produce a decoded message.


Claim 24 (canceled)


Claim 25 (previously presented): The method of claim 23, wherein the diffused errors are invariant to the graphically encoded message.


Claim 26 (original): The method of claim 23, wherein the base image is generated without foreknowledge of the original image.


Claim 27 (allowed): A method of decoding a graphical bar code, comprising:

generating a base image having halftone regions representative of an original image, wherein the base image is generated without foreknowledge of the original image and generating the base image comprises

measuring one or more intrinsic features of the graphical bar

code, and

based upon the intrinsic feature measurements, selecting a

sequence of halftone regions from a preselected set of

halftone regions permitted to represent regions of the

original image;

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probabilistically comparing regions of the base image to a set of graphical code words to obtain a sequence of graphical code words corresponding to a graphical encoding of a message; and

decoding the sequence of graphical code words to produce a decoded message.

Claim 28 (allowed):  The method of claim 27, wherein selecting the sequence of representative halftone regions comprises selecting a representative halftone region for each region of the graphical bar code likely to match a corresponding region of the base image.

Claim 29 (currently amended):  A computer program for decoding a graphical bar code, the computer program residing on a computer-readable medium and comprising computer-readable instructions for causing a computer to:

generate a base image having halftoned ~~halftone regions representative of an original image by halftoning~~ regions of an ~~the~~ original image incorporating diffused errors ~~diffused among regions of the original image and~~ computed based at least in part upon modulations in the graphical bar code ~~corresponding to a graphical encoding of a preselected message~~;

graphically demodulate the graphical bar code based on the base image to recover graphical code words embedded in the graphical bar code;

probabilistically compare the recovered graphical code words ~~regions of the base image~~ to a set of graphical code words to obtain a sequence of graphical code words corresponding to a graphical encoding of a message; and

decode the sequence of graphical code words to produce a decoded message.

Claim 30 (previously presented):  The method of claim 29, wherein the diffused errors are invariant to the graphically encoded message.